

CLAIMS

What is claimed is:

1. A method comprising:

transforming a signal;

adapting a first adaptive filter based on the transformed signal;

estimating a delay of an impulse response based on the adaptation of the first filter;

delaying a signal based on the estimated delay; and

adapting a second adaptive filter based on the delayed signal.
2. The method of claim 1, wherein transforming the signal comprises transforming the signal with a wavelet transform.
3. The method of claim 2, wherein transforming the signal comprises transforming the signal with a partial Haar transform.
4. The method of claim 3, wherein the partial Haar transform comprises a subset of basis vectors that span a full time range.
5. The method of claim 1, wherein estimating the delay comprises identifying one or more adapted coefficients of the first adaptive filter having extreme values relative to the other coefficients of the filter.
6. The method of claim 5, wherein estimating the delay comprises identifying an adapted coefficient having the largest absolute value.
7. The method of claim 1, wherein estimating the delay comprises transforming the estimate of the delay from a transform domain to a time domain.

8. The method of claim 1, further comprising reducing an echo based on the adaptation of the second adaptive filter.
9. An article comprising:

a storage medium having stored thereon data representing sequences of instructions that if executed cause an apparatus to:

transform a signal;

adapt a first adaptive filter based on the transformed signal;

estimate a delay of an impulse response based on the adaptation of the first filter;

adapt a second adaptive filter based on a signal that has been delayed based on the estimated delay.
10. The article of claim 9, wherein the instructions to transform further comprise instructions that if executed cause the apparatus to:

transform the signal with a wavelet transform.
11. The article of claim 9, wherein the instructions to transform further comprise instructions that if executed cause the apparatus to:

transform the signal with a partial Haar transform.
12. The article of claim 11, wherein the partial Haar transform comprises a subset of basis vectors that span a full time range.
13. The article of claim 9, wherein the instructions to estimate the delay further comprise instructions that if executed cause the apparatus to:

identify an adapted coefficient of the first adaptive filter having the largest absolute value.

14. The article of claim 9, wherein the instructions to estimate the delay further comprise instructions that if executed cause the apparatus to:

transform the estimate of the delay from a transform domain to a time domain.
15. The article of claim 9, wherein the instructions further comprise instructions that if executed cause the apparatus to:

reduce an echo based on the adaptation of the second adaptive filter.
16. An apparatus comprising:

a signal transformer to transform a signal to a transformed signal;

a first adaptive filter in communication with the signal transformer, the first adaptive filter to adapt based on the transformed signal;

a delay estimator in communication with the first adaptive filter, the delay estimator to estimate a delay associated with an impulse response based on the adaptation of the first adaptive filter;

a delayer in communication with the delay estimator, the delayer to delay a signal based on the estimate of the delay; and

a second adaptive filter in communication with the delayer, the second adaptive filter to adapt based on the delayed signal.
17. The apparatus of claim 16, wherein the signal transformer comprises a wavelet transformer.
18. The apparatus of claim 17, wherein the signal transformer comprises a partial Haar transformer.
19. The apparatus of claim 18, wherein the partial Haar transformer comprises a subset of basis vectors that span a full time range.

20. The apparatus of claim 16, wherein the delay estimator comprises a delay estimator to identify an adapted coefficient of the first adaptive filter having the largest absolute value.
21. The apparatus of claim 16, wherein the delayer comprises a delayer that is selected from the group consisting of a buffer and a delay line.
22. The apparatus of claim 16, wherein the first adaptive filter comprises a number of coefficients that is less than half a number of coefficients of a full-length adaptive filter for a channel corresponding to the apparatus, and wherein a number of coefficients of the second adaptive filter is based on a longest expected impulse response for the channel.
23. The apparatus of claim 16, wherein the delayer comprises a delayer to delay the input signal so that the second adaptive filter is substantially centered about the estimate of the delay.
24. The apparatus of claim 16, implemented in a network device including a switch fabric.
25. The apparatus of claim 16, implemented in a network device including a DRAM memory.
26. An apparatus comprising:
 - a DRAM memory; and
 - an echo canceller, the echo canceller including:
 - a signal transformer to transform a signal to a transformed signal;
 - a first adaptive filter in communication with the signal transformer, the first adaptive filter to adapt based on the transformed signal;

a delay estimator in communication with the first adaptive filter, the delay estimator to estimate a delay associated with an impulse response based on the adaptation of the first adaptive filter;

a delayer in communication with the delay estimator, the delayer to delay a signal based on the estimate of the delay; and

a second adaptive filter in communication with the delayer, the second adaptive filter to adapt based on the delayed signal.

27. The apparatus of claim 26, wherein the signal transformer comprises a partial Haar transformer.
28. The apparatus of claim 26, wherein the delay estimator comprises a delay estimator to identify one or more adapted coefficients of the first adaptive filter having extreme values relative to the other coefficients of the filter.
29. The apparatus of claim 26, further comprising a switch fabric.